

14. *HYLA AURANTIACA*, Daud.

15. *HYLA MARMORATA*, Laur.

The lighter parts of the sides of the belly, axilla, lower surface of thighs, and interdigital membranes orange.

16. *HYLA PARVICEPS*, Blgr.

17. *HYLA RUBRA*, Daud.

Loins, sides of thighs, and inner side of tibia and tarsus orange-yellow.

18. *PHYLLOMEDUSA PERLATA*, sp. n. (Plate LVIII. fig. 4.)

Tongue entire. Vomerine teeth none. Head very large; snout not longer than the diameter of the eye, vertically truncate; loreal region vertical; interorbital space much broader than the upper eyelid; tympanum rather indistinct, about half the diameter of the eye. Fingers free, first shorter than second, fourth shorter than third; toes free, first considerably longer than second; disks of fingers and toes small; metatarsal tubercles indistinct. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches hardly to the eye. Skin smooth above; parotoids large, flat; a series of small, pearl-like white tubercles from the eye to halfway down the body; belly and lower surface of thighs granulate. Purple above (green during life); a white, dark-edged line along outer border of forearm and tarsus; throat purple; lips white-bordered; the rest of the lower surfaces white. From snout to vent 23 millim.

A single young specimen.

4. On some Points in the Anatomy of *Phœnicopterus* and its Allies. By W. F. R. WELDON, B.A., Scholar of St. John's College, Cambridge, Assistant Demonstrator in the Morphological Laboratory of the University.

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(Plates LIX., LX.)

During the past summer I have had an opportunity of dissecting at the Society's Gardens a large number of Storks and a specimen of the European Flamingo (*Phœnicopterus antiquorum*), so that I have been able to make a detailed comparison between the soft parts of these creatures, the results of which I propose to describe in the following paper.

Respiratory System.

The *syrinx* of Storks has, as a rule, no intrinsic muscles; in *Leptoptilus*, which I shall take as a type, it has the following structure:—

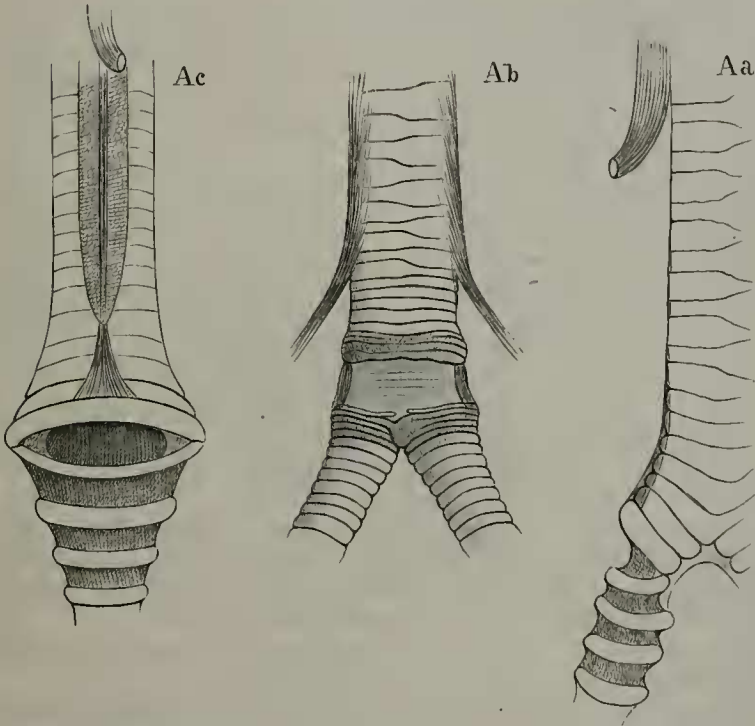
The last four bronchial rings (fig. 1, *Ab*,) are much enlarged,

fused together, and calcified, the fourth being incomplete behind. Above these are eight or nine rings, which are also incomplete posteriorly; so that above the syrinx there is at the back of the trachea an elongated membranous space.

Below the last tracheal ring there is a membranous tube, connecting the last tracheal with the first bronchial rings. Of these the first is incomplete internally, both in front and behind; while the next three are thickened, and join a large *pessulus* in the middle line.

Both the pessulus and the first four bronchial rings are complete. In *Phenicopterus* the last three bronchial rings are calcified and

Fig. 1.



Diagrams of the syrinx of *Leptoptilus* and *Phenicopterus*.

Aa, Front, and Ac, side view of that of *Phenicopterus*; Ab, front view of that of *Leptoptilus*.

ankylosed; there is no pessulus, and the first twenty bronchial rings are incomplete internally. There is also a single pair of intrinsic muscles (fig. 1, Aa, Ac).

The *lungs* present nothing remarkable, but the *air-cells* and their associated septa are strikingly characteristic.

On slitting open the abdominal wall of a Stork (*Leptoptilus*, for example) in the middle ventral line, the only viscera exposed are the two lobes of the liver and the ventral portion of the gizzard. All

the rest are hidden by a thick horizontal septum of connective tissue stretching across the whole body-cavity from the pericardium to the cloaca. The attachments of this septum are, *anteriorly*, to the posterior margin of the pericardium; *laterally*, to the side walls of the abdomen, just ventral to the line of attachment of the oblique septum; and *posteriorly*, to the body-wall just ventral to the anus.

The liver is, as has been said, entirely ventral to this septum, while the stomach perforates it.

The *umbilical ligament* is converted into a strong vertical septum, running between the lobes of the liver, and extending anteriorly to the pericardium, posteriorly to the middle of the gizzard (fig. 6, *v. sep.*).

This arrangement of septa is found in all the Storks I have dissected¹, and is exactly repeated in *Phœnicopterus*, while I have not found it in any other birds. In all the Anatidæ, for example, the representative of the horizontal septum is attached to the ventral abdominal wall, almost immediately behind the liver, so that it does not cover any of the intestinal coils².

The arrangement above described is associated, both in *Phœnicopterus* and the Storks, with a peculiarity in the air-cells themselves.

The *pulmonary aponeurosis*³ is not muscular.

The *præbronchial air-cells* vary greatly in size, and are divided by a complicated arrangement of transverse septa into smaller chambers; in *Leptoptilus* there are five such chambers in each cell, in *Phœnicopterus* four. This divided condition is not dependent on the size of the cells, because in *Phœnicopterus*, where they are small and deeply buried among the muscles of the neck, the dividing septa are as well developed as in the Adjutant, where each air-cell extends nearly a third of the way up the neck.

The *subbronchial cells* are completely fused, no trace of the original partition remaining. The fused cells project forwards between the clavicles, from which a small horizontal septum projects, partially dividing a præclavicular from a postclavicular portion.

The præclavicular portion is compressed by a muscle, which radiates over its outer surface from the clavicle.

The anterior and posterior intermediate cells present nothing remarkable, their relations being sufficiently shown. Indeed the condition of these cells seems, so far as I have been able to ascertain, to be singularly constant in all birds.

The *abdominal cells* are very large, extending to the extreme end of the body. The oblique septum, in the abdominal region, is attached to the vertebræ very near the middle line; passing ventrally, the two septa diverge, forming a chamber in which lie the

¹ *Leptoptilus argala* and *javanicus*; *Ciconia nigra* and *C. maguari*; *Mycteria americana*; *Tantalus* sp.?; *Carpodacus spinicollis*; *Xenorhynchus senegalensis*.

² This septum has been mentioned by various authors; but, so far as I am aware, no special name has been applied to it. From its resemblance to a modified Mammalian mesentery, I would propose to call it "*pseudepiploon*."

³ For an explanation of the terms used in describing air-cells, see Huxley, "On the Respiratory Organs of *Apteryx*," P. Z. S. 1882, p. 560 *et seq.*

intestines, below which they again converge to meet in the middle ventral line.

In the Anatidæ the præbronchial cells are never divided in the way above described, and the abdominal cells are much smaller, not extending so far back, and not meeting below the intestines¹—these two points, together with the condition of the horizontal septum, being, I believe, absolutely characteristic of the Storks.

The characters of the Alimentary System have been already described by Gadow², who has insisted on the resemblances between the Flamingo and the Stork; I have therefore nothing to add to his description.

The *muscular system* has, however, not been described in detail, either for Storks or for *Phenicopterus*. I propose therefore to describe first the limb-muscles of *Leptoptilus argala*, which is fairly typical, and afterwards to point out the chief differences in the Flamingo.

A. MUSCLES OF FORE LIMB.

1. The *latissimus dorsi* is divided, as usual, into two. The posterior division arises from the last two free dorsal vertebræ, and by a slip from the corner of the scapula; it forms a fleshy belly, tapering gradually to a point, and ending in two tendons, one of which goes to the humerus, the other to the belly of the *anconeus longus*. This muscle is connected by an aponeurosis with the *anterior division* which goes straight from the 3rd, 4th, and 5th dorsal vertebræ to the humerus.

2. The *trapezius* (Plate LX. fig. 7, *Tr.*) is very small, arising from the spines of the last two cervical vertebræ only, and going to the dorsal half of the clavicle. The posterior margin of this muscle sends off a small slip to the *latissimus dorsi*.

3. The *rhomboideus superior* arises from the spine of the fourth dorsal vertebra, beneath the *latissimus dorsi*, and is inserted into the vertebral border of the scapula. Beneath this muscle, and connected with it at its origin, is a flat, thin tendon, $\frac{3}{8}$ inch broad, going to the posterior angle of the scapula.

4. The *rhomboideus inferior* arises from the spines of the last cervical and first four dorsal vertebræ, and is attached to nearly the whole vertebral border of the scapula.

5. The *serratus magnus* arises by two fleshy digitations from aponeurosis between ribs 2, 3, and 4, just ventral to the uncinate process. It is inserted by a thin flat tendon to half an inch of the vertebral border of the scapula.

6. The *levator scapulae* arises from the last cervical and first two dorsal ribs, and is inserted into the posterior two thirds of the deep surface of the scapula.

7. *Tensor patagii brevis* (Plate LX. fig. 6, *t.p.b.*) arises by a fleshy origin from the dorsal part of the clavicle, and gives off a belly three

¹ Huxley (*loc. cit.*) has described the arrangement in the Duck; and I have found a similar state of things to obtain in many Anatidæ.

² Verdauungssystem d. Vögel: 'Jenaische Zeitschrift.'

inches long, after which it ends in a tendon. At the junction of the belly with the tendon, a tendinous slip is given off to the humerus. The tendon runs down, at a small angle with the humerus, and joins the aponeurosis over the extensor carpi radialis, where it receives a slip from the tensor patagii longus tendon.

8. The *tensor patagii longus* is fused at its origin with the *pectoralis major*, and after leaving this it fuses for a short distance with the fleshy part of the *tensor brevis*. The tendon runs straight to the radial carpal bone, giving off about the middle of the patagium a slip to the aponeurosis over the flexor carpi radialis.

The result of the arrangements described is, that the tendons of the patagial tensors form a very characteristic figure, shown in fig. 8.

9. The *coracobrachialis externus* arises from the tip of the clavicle dorsal to the tensor patagii brevis; it runs above the coracobrachialis internus, to be inserted into the middle of the great humeral crest.

10. The *coracobrachialis internus* is very small; it arises from the tip of the coracoid, just ventral to the coraco-scapular articulation, and passes over the tendon of the second pectoral to the crest of the humerus.

11. The *external deltoid* arises by a short flat tendon from the outer face of the scapula, close to the coracoid articulation; it runs straight to the humerus, into the dorsal face of the crest of which it has an elongated triangular insertion. Close to the origin a second tendon is given off to the scapula (Plate LIX. fig. 1, D, Plate LX. fig. 6, DE).

12. The *deltoides internus* arises from the tip of the coracoid, external to the long tendon of the biceps, and goes to the ventral side of the humeral crest (Plate LIX. fig. 1, Dt).

13. The *triceps* arises from the whole posterior face of the humerus, below the pneumatic foramen; it is fleshy for nearly its whole length, but ends below in a short tendon inserted into the olecranon.

14. The *pectoralis major* arises by three heads, the fibres of which are all tolerably distinct:—(1) The *superficial head* arises from the margin of the clavicle ventral to the origin of the *tensor patagii brevis*, from the extreme edge of the carina of the sternum along its whole length, and from the whole side posteriorly. The fibres of this head are continuous posteriorly with (2) the *posterior deep head*, which arises from the ventral third of the clavicle, and from the carina beneath the first head. (3) The *anterior deep head* arises from the ventral face of the sternum beneath (2), and from a small piece of clavicle.

These various fibres are inserted in a somewhat complicated manner on the head of the humerus. Those from the anterior deep head, remaining quite distinct from the rest, form a strong tendon, which is attached to a tubercle at the base of the deltoid crest of the humerus. From the junction between this muscle and its tendon, a strong ligament passes to the head of the coracoid. From the posterior edge of this tendon, a strong aponeurosis passes over the

internal deltoid and biceps, to be inserted into the inner side of the humerus; and to this aponeurosis are attached the remaining fibres of the pectoralis.

15. The *second pectoral* occupies about three quarters of the ventral face of the sternum; it also arises from the proximal half of the coracoid, and from nearly the whole of the coraco-clavicular membrane. Its tendon passes as usual over the scapula to go to the lesser tuberosity of the humerus, at the top of the deltoid ridge.

16. The *third pectoral* is relatively small; it arises from the lower third of the posterior margin of the coracoid, and passes to the tip of the great tuberosity of the humerus.

17. The *biceps* arises by two heads—a long tendon from the head of the coracoid, and a fleshy head from the lower surface of the pectoral aponeurosis.

18. The *supraspinatus* arises from the anterior half of the ventral border of the scapula, and is attached to the great tuberosity of the humerus, just anteriorly to the tendon of the *pectoralis tertius*.

19. The *subscapularis* arises from the anterior half of the deep surface of the scapula, being inserted into the great tuberosity of the humerus below the tendons of the third pectoral and supraspinatus.

20. The *extensor carpi radialis longus* arises by fleshy fibres from the ridge above the outer condyle of the humerus, and forms a short fleshy belly, which joins a long tendon, passing first over a groove in the distal head of the radius, and then over the middle of three grooves on the face of the radial carpal, to be finally inserted into the tuberosity of the thumb metacarpal.

21. The *extensor carpi radialis brevis* arises by a short tendon from the outer condyle of the humerus; its short belly is attached to the aponeurosis covering the preceding muscle, and its tendon runs below the long extensor tendon to the thumb metacarpal.

22. The *abductor pollicis* arises by three slips—the first from the interosseous border of the radius for about a third of its length, beginning near the bicipital tuberosity; the second from the upper surface of the ulna, just beneath the head of the radius; and the third from a ridge on the ulna, just distal to the ulnar tendon of the biceps. The second and third slips unite before joining the first.

The tendon curves round to the outer side of the radius, and passes through the outer of three grooves on the radial carpal bone, to be inserted on the great tuberosity of the thumb metacarpal, below and external to the radial extensor of the carpus.

23. The *extensor carpi ulnaris* arises from the outer surface of the outer condyle of the humerus, superficially to all the other muscles which arise there; it is also attached to the outer side of the ulna. The belly is small, and the long tendon passes through a separate groove in the outer side of the ulna to the outer side of the second metacarpal.

24. The *adductor manus* arises from the fascia on the outer side of the head of the ulna, and passes to the inner edge of the third metacarpal.

25. The *pronator quadratus* arises from the inner (palmar) surface

of the ulna through the distal fourth of its length, and passes over the dorsal groove in the radial carpal bone to the tubercle on the outer side of the thumb metacarpal.

26. The *flexor carpi ulnaris* arises from the inferior portion of the internal condyle of the humerus; it is fleshy for half its length, and then sends a tendon to the tubercle of the ulnar carpal.

27. The *extensor indicis et pollicis* arises from the outer condyle, and is inserted on the basal phalanx of the index finger, the tendon giving a branch to the thumb.

28. The *extensor proprius indicis* arises from two thirds of the distal half of the interosseous border of the radius; it crosses the tendon of the ext. ind. et poll. to go to the base of the distal phalanx of the index. About the middle of its course through the hand, the tendon is joined by a slender muscular slip arising from the capsule of the tarso-metatarsal joint.

29. *Flexor indicis* I arises from the deep surface of the proximal half of the ulnar fascia, going over a groove in the ulna to the upper surface of the second phalanx of the index.

30. *Flexor indicis* II arises from the proximal half of the deep surface of the ulna, and goes to the base of the second phalanx of the index.

31. *Brachialis anticus* arises from the outer part of the anterior surface of the humerus, between the epicondylar ridges, and inserted to the inner margin of the ulna by a fleshy insertion two inches long.

32. The *pronator longus* has a tendinous origin, superficially to all other muscles, from the inner condyle of the humerus; its insertion into the humerus is very long.

33. *Pronator brevis* lies below the long pronator, and has similar attachments.

34. The *supinator* arises from the outer condyle above the extensor indicis et pollicis, and is inserted into about four inches of the superior margin of the radius.

35. The *extensor brevis pollicis* arises from the proximal dorsal tubercles of the thumb metacarpal, and goes to the dorsal edge of the base of its phalanx.

There are two abductors and one short flexor of the thumb.

B. MUSCLES OF THE HIND LIMB.

1. The *sartorius* arises from the antero-inferior margin of the crista ilii, and is not attached to any dorsal vertebra; it is inserted into the tibia on the inner side of the triceps tendon.

2. The *tensor fasciæ* arises from the gluteal fascia in front of the acetabulum only in *Leptoptilus*, though in some Storks (*Ciconia*) its origin extends behind the acetabulum. It is inserted into the fascia covering the rectus femoris.

3. The *biceps* arises from nearly the whole of the postacetabular ridge of the ilium; its tendon, after passing through the usual sling, goes to the fibula, about two and a half inches below the head.

4. The *semitendinosus* is rather narrow ; it arises from the tip of the postacetabular ridge of the ilium, and from the fascia between this and the pubis. It is inserted (1) into the tendon intersecting its accessorius ; and (2) into a flat tendon which passes round the accessorius to join the tendon of the semimembranosus.

5. The *semimembranosus* arises from the hinder end of the ischium, and a small piece of the pubis. Its flat tendon receives, as has already been said, the tendon of the preceding muscle.

6. The *accessory semitendinosus* arises from the point of insertion into the femur of the great adductors ; it then goes to the tendon already mentioned, which receives on one side the semitendinosus, on the other its accessorius, and finally goes to join the middle head of the gastrocnemius.

7. The *ambiens* is small ; it has the normal relations described by Garrod.

8. There are three glutei, all of which are large.

9. The *obturator externus* arises from the anterior half of the ischium behind the postacetabular foramen. Its origin is fleshy ; its upper surface is tendinous, covered by a thick and strong aponeurosis.

10. The *obturator internus* has an oval origin ; round its tendon there is, as usual in birds, a single representative of the gemelli.

11. The *adductor longus* is attached to the ischium behind the obturator foramen ; it is inserted into the linea aspera along the distal three fourths of the femur, the ventral face of the inner condyle, the capsular ligament of the knee-joint, and the head of the tibia.

12. The *adductor magnus* arises from the external face of the adductor longus ; it is inserted along the outer edge of the middle third of the linea aspera, where it fuses with the accessory semitendinosus.

13. The *pectineus* arises just internal to the gluteus quartus and is inserted on the inner side of the femur, between the rectus and vastus internus.

14. The *quadriceps femoris* is made up of a fused *rectus* and *vastus externus*, the *vastus internus* being distinct. The last-named muscle, as well as joining the common tendon at the patella, has a small separate tendon going to the *outer* side of the tibial crest.

15. The *gastrocnemius* arises by three heads:—(a) the *inner* arises from the tendon of the *rectus*, from the fascia covering the inner surface of the *tibialis anticus*, and from the cnemial crest of the tibia. It forms a large fleshy belly, which remains distinct from the rest of the muscle till the tendo Achillis.

(b) The *middle* head arises by a flat narrow tendon between the condyles of the femur ; it then forms a small belly, joined by the accessory semitendinosus, and then going to the outer head.

(c) The *outer head* has a very short thin tendon arising from the outer condyle of the femur, between the biceps sling and the origin of the flexor perforatus et perforans.

The result of this arrangement is that the muscle has a very curious shape, shown in the accompanying woodcut.

16. The *flexor perforatus et perforans* arises by two heads—one from the outer condyle of the femur, just distal to the outer head of the gastrocnemius, and one from the fascia over the peroneus longus: the two heads are connected by a tendinous intersection. The two heads give rise to two separate tendons, which pass the ankle-joint on the inner side of the leg, just below the tendo Achillis. They supply the second and third digits.

17. The *flexor perforatus* arises from the femur by a flat tendon from the inner condyle, and by a fleshy head from the outer: these heads unite to form a fleshy belly, which receives two slips from the *flexor perforatus et perforans*. After receiving these slips the muscle splits into three tendons, which at the annular ligament are internal to the tendons of the *flexor* last described, and superficial to those of the *flexor profundus*.

18. The *flexor profundus* arises from the whole length of the fibula and the adjacent parts of the tibia. Above, the tibial and fibular portions are more or less distinctly separable; and further down the belly the separation is continued by a tendinous raphe. There is a single tendon, which passes through the annular ligament below all the others.

19. The *flexor longus pollicis* has the typical arrangement called "ciconine" by Garrod.

20. The *peroneus longus* arises from the crest of the tibia and from the fascia covering the tibialis anticus; also from the fascia between itself and the head of the gastrocnemius. All these origins are fleshy. A broad, flat tendon passes to the outside of the leg, at the ankle, through a special groove in the outer malleolus of the tibio-tarsus, joining the tendon of the *flexor perforatus* about a third of the way down the tarso-metatarsus. Just before passing the ankle-joint the tendon gives off a broad flat ligament to the tibia.

There is no *peroneus brevis*.

21. The *tibialis anticus* arises from the outer condyle of the femur, from the upper and outer side of the cnemial crest of the tibia, and from the aponeurosis covering the extensor communis digitorum. The tendon passes superficially through the anterior annular ligament, and is inserted into a pit in the tarso-metatarsus about an inch below the joint.

22. The *extensor communis digitorum* has a fleshy triangular origin from the inner border of the anterior face of the tibia for about five inches: its tendon is first beneath, then internal to that of the *tibialis anticus*, and supplies the second, third, and fourth digits, but not the thumb.

23. The *plantaris* arises from the inner side of the posterior surface of the tibia for about an inch; its belly is very small; and its long slender tendon is inserted into the deep surface of the annular ligament.

24. There are two poplitei.

The short muscles of the foot are an abductor, an abductor indicis, a small flexor of the middle finger, and an abductor minimi digiti, on the dorsal side: on the ventral side are a short flexor of the hallux, and a short flexor of the second toe.

The foregoing account, without making any pretence to completeness, may serve as a standard of comparison in considering the myological affinities of the Flamingo.

In the fore limb this animal agrees so closely with the Storks that it would be useless to go into any detailed description of its wing-muscles.

The most important points of agreement, however, are the features of the pectoralis major and of the tendons of the *tensores patagii*. In Storks it is well known that the pectoralis major is divided into two or more layers, easily separable from one another, and that its attachment to the humerus forms a tendinous arch beneath which the brachial muscles pass from the coracoid to the arm. In *Phœnicopterus* Gadow¹ has shown that these features are exactly repeated; and in Plate LX. fig. 7 I have drawn a specimen in which it seems as if there were actually two distinct great pectorals. I need hardly point out that this condition is absolutely unknown among Lamellirostres.

Fig. 2.

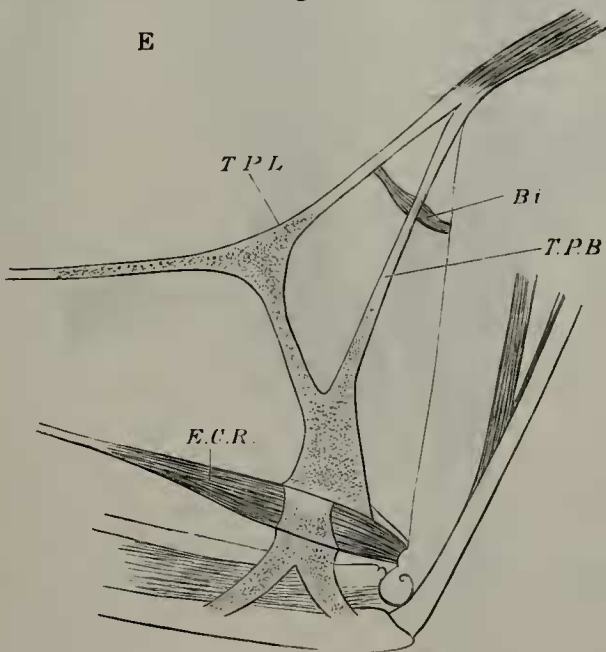


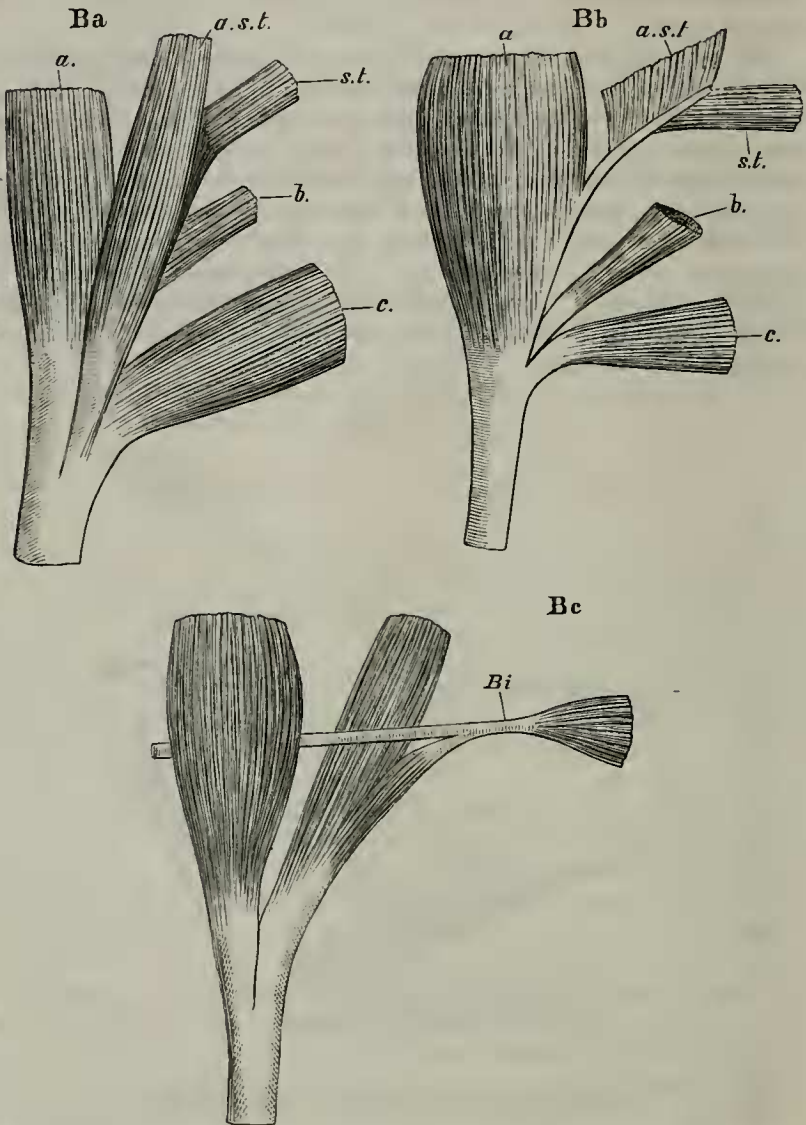
Diagram of *tensores patagii* in *Phœnicopterus*.

The *tensores patagii* form in *Phœnicopterus* almost exactly the same figure as that found in Storks, as will be seen at once by comparing fig. 2, E with Plate LX. fig. 6; while in the Duck, for example (see Plate LX. fig. 8), there is a marked difference from this type, neither tendon sending a slip down to the flexor carpi radialis, and the whole triangle of the patagium being filled by a strong, even aponeurosis.

¹ Journ. f. Ornithol. 1878.

In the leg the agreement is not quite so close, the Flamingo having many muscular features of its own ; but in those points in

Fig. 3.



Gastrocnemius and connexions: *Ba*, in *Leptoptilus*, *Bb*, in *Phœnicopterus*, *Bc*, in the Duck.

a., inner, *b.*, middle, *c.*, outer head of gastrocnemius ; *s.t.*, semitendinosus ; *a.s.t.*, its accessorius. In the Duck, *Bi*, biceps.

which it does resemble other forms, it tends much more to the Ciconine than to the Anserine type.

The *sartorius* is peculiar in being split up into three distinct por-

tions, separate in origin and insertion, but so situated that each has almost all the relations of the typical sartorius.

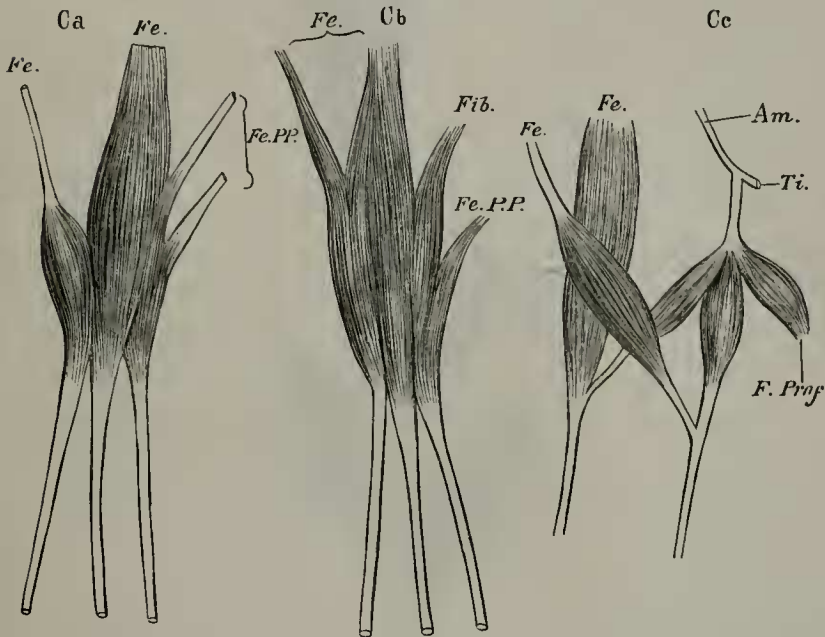
Of the *tensor fasciæ* only the post-acetabular portion is left.

The *biceps*, *semimembranosus*, and *semitendinosus* closely resemble those of the Storks, as does also the mode of union of the accessory semitendinosus with the gastrocnemius.

There are two distinct *adductors*, as in Storks, while in many, if not in all, Geese there is only one.

The *ambiens* is small, and simply joins the flexor perforatus in the leg; while in Anatidæ it acquires a connexion with the tibia on the one hand, and with both the flexors on the other.

Fig. 4.



Diagrams of origin of *flexor perforatus*: Ca, in *Leptoptilus*, Cb, in *Phænicopterus*, Cc, in the Duck.

Fe., Attachment to femur; *Fe.P.P.*, slips to flexor perforatus et perforans. In Duck, *Am.*, ambiens tendon; *Ti.*, its tibial insertion; *F. Prof.*, one belly of flexor profundus.

The three-headed origin of the *gastrocnemius*, and its mode of union with the *accessory semitendinosus* are also essentially Stork-like. In the Duck, for example, where there is no accessory semitendinosus, there are only *two* heads to the *gastrocnemius*, the inner of which receives a muscular slip from the tendon of the biceps.

These relations will be easily understood on comparing in fig. 3, p. 648, Ba and Bb with Bc.

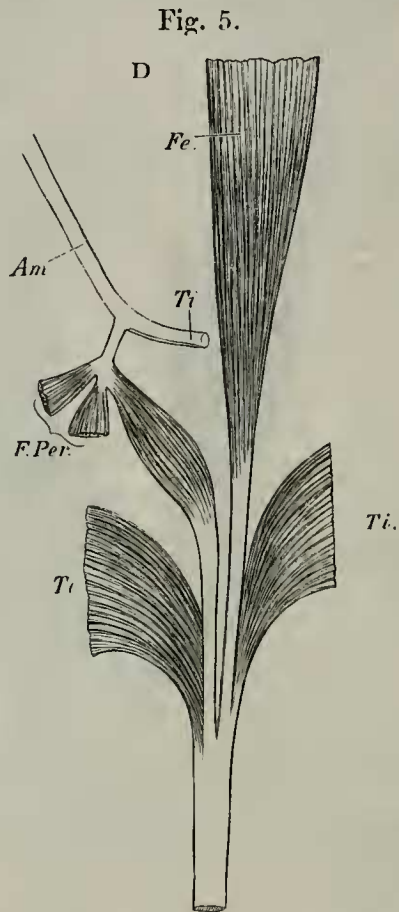
The *long flexors of the leg* are also very Stork-like.

The *flexor perforatus* in *Phænicopterus* arises by four heads, one

of which is fused with the flexor perforatus et perforans. This mode of origin is very similar to that of Storks; while in the Duck, for example, there are two heads attached to the femur, and a third to the ambiens tendon.

These conditions are shown in fig. 4, p. 649.

The *flexor profundus* is perfectly simple both in Storks and in the Flamingo; while in the Ducks (fig. 5) it has a complicated origin by four heads—namely, one from the femur, one from the outer and one from the inner side of the tibia, and one from the ambiens tendon,



Origin of flexor profundus in Duck.

Ti., insertions to tibia; other letters as in fig. 4.

which does *not* simply fuse with the belly of the flexor, but goes to the tibia, and gives attachment to two distinct fleshy bellies, one for each long flexor.

The accessory femoro-caudal of *Phœnicopterus* is extremely small; and the possession of this muscle together with the absence of a

long flexor of the hallux are almost the only points in which it differs from a Stork.

In conclusion I may point out an osteological comparison of some importance, which so far as I can learn has not been noticed.

In the group of Storks the number of dorsal vertebræ is very constantly *five*, of which one is covered by the ilium, the "sacral" vertebræ (all those between the last dorsal and first free caudal) being as constantly fourteen, while the free caudals, excluding the pygostyle, are five or six in number.

The following table shows the relations in this respect of Storks, Flamingoes, and those Geese which I have examined.

Genus.	Dorsal.	Sacral.	Caudal.
<i>Storks.</i>			
<i>Ciconia</i>	4+1	14	6
<i>Tantalus</i>	4+1	14	6
<i>Leptoptilus</i>	4+1	14	6
<i>Abdimia</i>	5+1	14	6
<i>Xenorhyncha</i>	4+1	14	?
<i>Phœnicopterus ruber</i>	5+2	14	6
— <i>antiquorum</i>	5+1	14	6
<i>Geese.</i>			
<i>Plectropterus</i>	5+3	13	7
<i>Bernicla</i>	4+4	13	7
<i>Dendrocygna</i>	5+2	13	6
<i>Sarcidionis</i> ..	5+3	13	6
<i>Edemia</i>	5+3	14	7
<i>Fuligula</i>	5+3	13	7
<i>Cygnus</i>	5+3	13	7

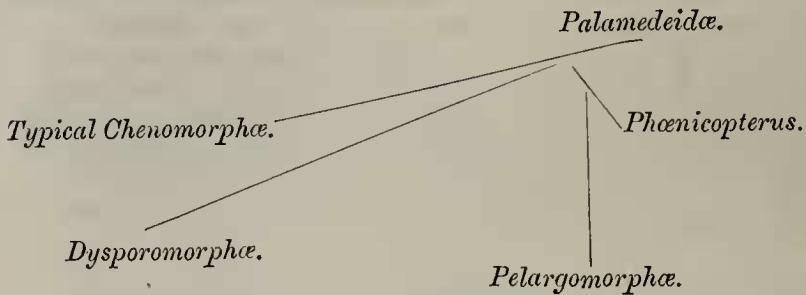
[In this table the dorsal vertebræ are separated by the + sign: those in front of it being free, those behind it being covered by the ilium. Thus 5+3 means five free dorsal vertebræ and three covered by the ilium.]

Further, in all the above-named Storks and in *Phœnicopterus* the radius is *more than twice as long as the first metacarpal*, while in all the Geese that I have examined it is less than twice as long.

I think, therefore, that while the skull and larynx of *Phœnicopterus*, together with its webbed feet and the characters of its bill, undoubtedly connect it with the Lamellirotres, yet the rest of its organs—its air-cells, its muscles, its alimentary canal, its vertebral column, and the characters of its wing-bones—show close relationship with the Storks.

In fact, if we assume that the typical *Chenomorphæ* are descended from a group similar to that now represented by the Screamers, with their simple desmognathism and complete muscle-formula, we may

place *Phenicopterus* in the same sort of relation to the typical *Pelargomorphs*, thus:—



a relationship which is exactly expressed by the term Amphimorphæ of Professor Huxley.

EXPLANATION OF PLATES LIX. AND LX.

PLATE LIX.

- Fig. 1. Shoulder-muscles of *Ciconia maguari*; outer view.
 2. Thigh of *Phenicopterus*; outer side.
 3. Thigh of *Leptoptilus argala*; outer side.
 4. Calf-muscles of *Phenicopterus*.

PLATE LX.

- Fig. 5. Calf muscles of *Leptoptilus*.
 6. Arm-muscles of *Leptoptilus*, showing arrangement of *tensores patagii*.
 7. Dissection of *pectoralis major* of *Phenicopterus*.
 8. *Tensor patagii* of Duck.

Complete list of reference-letters:—

- An.* Anconeus longus.
a.s.t. Accessory semitendinosus.
Bi. Biceps.
bi'. Reflected tendon of biceps-sling.
c.b.₁, *c.b.₂* Coracobrachialis.
D.I., *D.E.* Internal and external deltoids.
Fl. perf. Flexor perforatus.
Fl. prof. Flexor profundus.
Fl.p.p. Flexor perforatus et perforans.
g, *g₁* Gastrocnemius.
l.d. Latissimus dorsi; *ld₁*, *ld₂*, its anterior and posterior divisions.
P.M.₁, *P.M.₂* Divisions of great pectoral.
P. II. Second pectoral.
s.t. Semitendinosus.
s.m. Semimembranosus.
t.p.l., *t.p.b.* *Tensores patagii*.
t.f. Tensor fasciæ.